The American Biology Teacher

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The American Biology Teacher

Vol. 9 APRIL, 1947 No. 7

Using the Mosquito in Teaching Biology

R. A. BULLINGTON
MacMurray College, Jacksonville, Illinois

The progressive teacher of biology is ever on the alert to bring to his classroom and laboratory teaching materials and methods that are interesting to the student and are of practical value. The suggestions given here concerning the study of mosquitoes are offered in the hope that they will prove useful to biology teachers and also to teachers of general science. These ideas are the result of the writer's first-hand knowledge of mosquito control work and experience in the classroom.

The technical aspects of the subject are purposely omitted and emphasis is placed upon practical phases of the study of mosquitoes. In biology textbooks and workbooks the teacher can readily find the details of mosquito structure, life history, generic characteristics, and transmission of disease. With this information as a foundation, the teacher can guide his students through many fascinating phases of study. Little specialized knowledge is needed and only very inexpensive equipment is necessary. Some parts of these suggestions can be adapted for practically any community in the nation, at least wherever there are mosquitoes.

Raising Mosquitoes

Students will enjoy watching the development of mosquitoes in the classroom. This project may be undertaken at various seasons of the year. In the spring, larvae can be gathered in woodland pools, flooded marshes, and wet vacant lots after the first heavy rain. They hatch from eggs laid on dry ground the summer or autumn before by various species of *Aedes* females. A tin dipper with a long handle and some glass jars make suitable collecting equipment.

If there is no flooding in the spring, nature's processes may be aided by securing some sod from dry low ground known to have produced mosquitoes in the past, placing it in a tub, and flooding it with warm water. If eggs are present on the sod, some of them will hatch almost immediately. It may be necessary to try sods from several sources. These sods may be secured at

Raising mosquitoes in the biology laboratory. All photographs in this article are by courtesy of J. Lyell Clarke, Sanitary Engineer, DesPlaines Valley Mosquito Abatement District, Lyons, Illinois.

any season of the year when the ground is dry.

In the autumn, it is convenient to secure the eggs and larvae of the domestic mosquito, *Culex*. One needs only to look in the nearest rain barrel, stagnant pool, polluted stream, or any bit of standing water. Many eggs and larvae will probably be discovered.

In the southern states, it may be possible to secure *Anopheles* larvae from among the vegetation at the margin of some pond or stream. Or on a seacoast the salt marshes may provide an abundance of larvae.

No matter what the source, the larvae may easily be kept alive for study. Place them in water in glass jars or finger-bowls. Do not use tap water, but water from some pond or stream, for it will contain microorganisms for larval food. Secure some glass lantern chimneys and cover the smaller opening with mosquito netting or gauze, using glue or cellulose tape for fastening. Place the chimney open end down over the container of larvae. (See large photograph.) When adults emerge, they will collect in the chimney. The chimney full of adults may then be removed by placing a piece of cardboard under the open end.

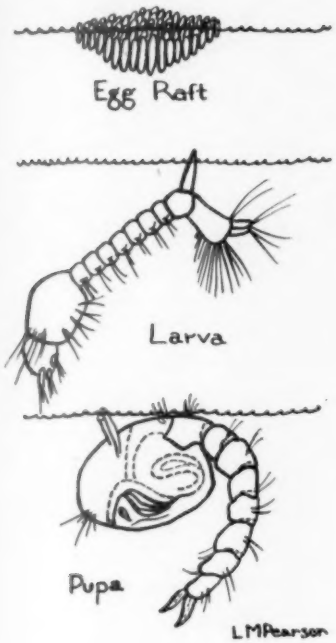
The adults may be fed on sugar water absorbed in cotton, ripe fruits such as grapes, or on human or animal blood. By means of the chimney the thirsty creatures may easily be transferred to arm or leg.

With the living forms available students can carry on many interesting studies. Some suggestions follow. The teacher will need to fill in the details, and adapt the projects to the local situation. No attempt is made in this short paper to describe the expected results. Of course, in many cases they are obvious.

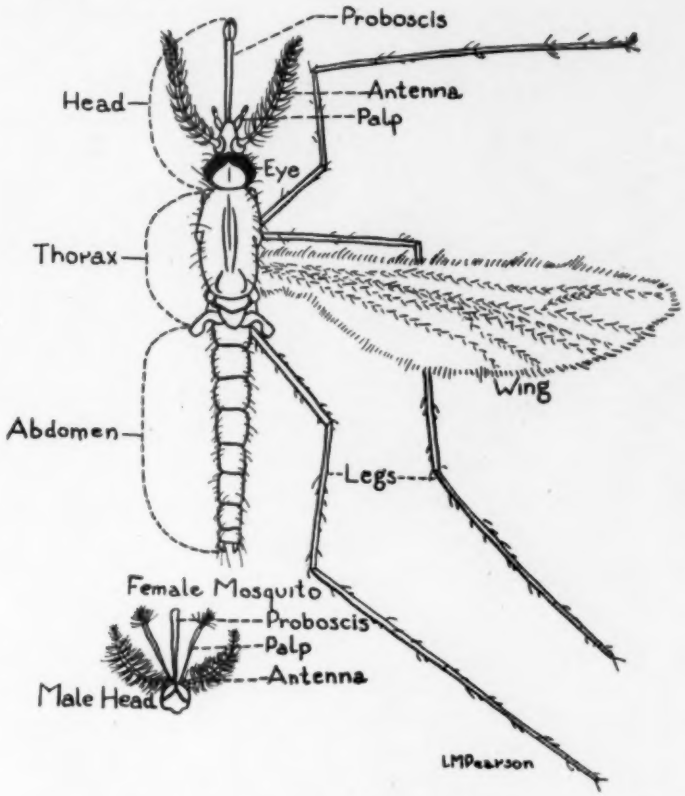
Projects for Study

1. Structure of eggs, larvae, pupae, and adults. A low-power binocular microscope is excellent for studying structure. A good hand lens is also useful. Note the shape of the eggs and their position in water. Observe the place of emergence of the larvae. Note the segmented body structure of a larva and examine the head, mouth parts, and breathing tube. Note the hairs and bristles on head, body, and tube. These aid in identification. In the pupa, note the shape of the body and the number and position of breathing tubes. In the adult, note body parts, number of legs and wings, antennae, mouth parts, and special markings.

2. Metamorphosis. Watch the larvae shed their skins as they grow. Note the change from larva to pupa. Observe the adult emerging from the pupal case and using it for a raft as the wings dry.



The stages in the life history of the domestic mosquito, *Culex*, likely to be found in standing water from late spring to autumn.



The structure of a typical adult mosquito—note greatly enlarged palps of the male.

3. Activity. Watch the behavior of larvae. How long do they remain submerged before coming up for air? Compare larvae and pupae in this respect. Which are more active? Compare Anopheline larvae with others. Note their different position in the water. Note that they feed at the surface of the water by turning the head. Do mosquito pupae take food?

4. Longevity. Note the length of time spent in each stage under normal conditions. Interesting experiments may be conducted by varying the conditions under which larvae grow and observing the changes in rate of maturing. Such factors as temperature, food, acidity or alkalinity of water, degree of sewage pollution, etc., can easily be controlled in the laboratory.

5. Sex differences in adults. Note the bushy antennae and enlarged palps of the adult male. Compare with the female. Observe the differences in mouth parts and the adaptation of the female parts to their function of bloodsucking. A skillful student or the instructor may dissect these parts and prepare a microscope slide of them.

6. Biting. Make daily studies of the biting tendencies of the females. (Willing blood donors may be found in the class, at least the first time!) At what age do they begin to bite? How much time is required to complete a blood meal? Do the adults of all the species

A typical mosquito breeding area.

available seek blood? (Some species are not known to bite man.) If *Anopheles* are available, compare their biting position to that of other genera.

7. Repellents. After the bloodthirstiness of a group of mosquitoes is established, compare the effectiveness and the lasting qualities of various repellents that are available on the market.

8. Testing larvacides. A common method of controlling mosquitoes is the application of some lethal material to water containing larvae. Paris green is commonly used for the surface-feeding *Anopheles*, which eat the particles of this arsenic compound and are poisoned. Other mosquitoes are controlled by spraying oil or an emulsion containing a poison such as pyrethrum or D.D.T.

It is commonly believed that the oil on water smothers the mosquito larva by excluding air from its breathing tube. It is more likely that the oil exerts a toxic effect and poisons rather than smothers the larvae. Different oils producing equally good films may kill larvae in widely varying times. Some may not kill them at all. Many illuminating experiments can be performed in the laboratory with larvacides.

For example, place ten large larvae in clear water in each of a number of clean finger bowls. On each, place one drop of a sample of oil. Try such materials as diesel oil, kerosene, and different grades of fuel oil. Note the length of time that is necessary to kill all the larvae in a dish. The time will vary considerably with different oils.

Various dilutions of pyrethrum or D.D.T. may also be used. In some communities samples of larvacide emulsions in actual field use can be obtained and tried.

9. Biological control. If certain living materials can be obtained, some interesting observations on the balance of nature may be made. Place mosquito larvae in an aquarium containing bladderwort. At least the smaller larvae will be captured. How does the plant accomplish this? Note the appetite for larvae of such forms of water life as the top-minnow (*Gambusia*), small sunfish, guppies, water boatmen, whirligig beetles, larvae and adults of the water scavenger beetle and predaceous diving beetle, and dragonfly nymphs. Many students will delight in collecting these things for the school aquarium.

Is nature alone, in any situation, capable of completely controlling mosquitoes? Such a proposition can be easily tested in an outdoor garden pool or small pond. This could be developed into an informative class project.

If the above activities have stimulated the interest of the pupils, here are some additional exercises that individuals, committees, or the whole class might try.

Additional Exercises

1. Mosquito survey. Each student could survey his home premises for evidence of mosquito breeding. A block by block survey of the community could be made. Wherever mosquito production is discovered, steps could be taken to eliminate the nuisance.

2. Visit mosquito control agency. If there is a mosquito control organization nearby, plan to visit the headquarters

and have the work explained and methods demonstrated by the men in charge.

3. Study laws. Many states have specific laws concerning mosquito control and the establishment of local control agencies. Investigate your own state laws.

4. The mosquito and disease. Most students are familiar with the fact that mosquitoes transmit malaria and yellow fever. There are several other less familiar diseases of humans and the higher animals that are carried by mosquitoes. A study of these diseases is a worthwhile library project.

5. Mosquitoes in warfare. During the recent war our armed forces battled constantly against the mosquito as a pest and distributor of disease. D.D.T. and the aerosol bomb were potent weapons against the enemy. Read the extensive literature on this phase of warfare.

6. Hibernating adults. Make a search during the colder months for hibernating *Culex* or *Anopheles* females. They may be found clinging to walls in basements, barns, sewers, catch basins, and in many unscreened buildings. Take the adults into the classroom. Can they be induced to wake up and take blood? Will they lay eggs on water provided?

7. Conservation. In mosquito control compatible with wild life conservation practices? Can mosquito marshes be drained without harming or destroying much useful plant and animal life?

This very pertinent problem has been sensibly treated in the Chicago area in particular. Many prolific mosquito marshes have been dammed or deepened to make them permanent bodies of water, providing a "wild life oasis" which is a sanctuary for aquatic life and a haven for many birds and water-loving animals.

Can D.D.T. be sprayed on water to destroy larvae without injuring aquatic plants, fish, water fowl, plankton, and other life? Much research work is being done on this problem. The student can find numerous references for and against the use of D.D.T. They are worth investigating.

Flooded woodland area is a prolific source of mosquitoes.

What is the relation between stream and pond pollution, conservation, and mosquito control? It will be found that pollution that is harmful to most desirable wild life is favorable to the development of domestic mosquito. Students may investigate this problem in their community. Is a clear pond or stream being polluted by sewage, factory waste, dairy washings, or garbage dumping? Is this polluted water producing many mosquitoes? Can anything be done about it?

Through a study of the mosquito, many biological principles can be taught. Much practical knowledge will be gained by the student.

The student will learn how many areas of human endeavor and many diversified and conflicting interests must be coordinated to control this disease-carrying and annoying pest.

NATIONAL BOYS AND GIRLS WEEK will be observed from April 26 to May 3, 1947. The celebration will mark the 27th annual observance of this important youth event. With the theme, *Youth—the Trustees of Posterity*, the program is designed to focus attention on the problems, interests, and recreations of youth, and on the part played by home, church, school, and youth-serving organizations in the development of character and good citizenship in growing boys and girls.

An Introductory Course in Biophysics

KARLEM RIESS
Tulane University, New Orleans, Louisiana

The importance of physics in the premedical curriculum has been recognized for many years. In almost all universities one year of general physics is a prerequisite for admission to a medical school. Because of this brief exposure to physics very few of the medical students have an adequate knowledge of the subject. They do not appreciate the importance of physical principles in the study of biological phenomena. This criticism also applies to biology majors. In many universities they may complete a degree program without a single course in physics.

Modern biophysics is that branch of applied physics which utilizes the principles and techniques of physics for the investigation of biological and medical problems. Introductory courses in biophysics are specially designed for the premedical students and the biology majors. Such a course has been given at Tulane University for several years and is recognized as a valuable part of our undergraduate program.

There are many possible procedures and methods of organization for such a course. The time allotted to the course will determine the number and variety of topics developed. We have experimented with three types of courses—one, two, or three hours per week, with equivalent semester hours of credit. The one-hour course has been the most popular, possibly because it is easy to schedule in an already crowded curriculum. However, many of the students have requested the three-hour course. Topical outlines for both one-hour and three-hour courses are appended to this article. Both are based on fifteen-week semesters.

The course (either one-hour or three-hour) is opened with a discussion of X-rays. These may or may not have been mentioned in the general physics course, but are familiar to the student. Topics treated include the nature and production of X-rays, absorption of X-rays, X-ray scattering—the Compton effect, the effect of X-radiation on living tissue, protection from X-radiation, X-ray therapy, intensity measurements and detection of X-rays. For example, it should be pointed out that studies of the nature of chromosomes and of mutations caused by X-rays have been of great value in our efforts to understand the living plant and animal cell. The new betatron and synchrotron as sources of strong X-radiation provide an interesting project for investigation.

Natural radioactivity may be correlated with the discussion of X-rays. The disintegration of uranium, thorium and actinium, their disintegration products and the nature of alpha rays, beta rays and gamma radiation are stressed. Radioactive decay is discussed in terms of half life and average life values. With this as an introduction a more detailed study is centered around radium and radon. The methods of preparation of radium and radon for biological uses, the units of measurement—the curie, millicurie and biological roentgen—are introduced. Radium and radon dosage, methods of therapy and tissue reaction to the radiations are but a few of the many biological applications.

Method sof producing artificially radioactive materials, such as the Rutherford and Curie-Joliot experiments, are links between chemistry, biology, and

physics. The cyclotron and its use in the production of radioactive "tracers" is of great importance today. The students are deeply interested in tracer experiments, such as the use of radioactive phosphorus (P–32) in the study of bone, radioactive calcium (Ca–49) in the metabolism tests, radioactive carbon (C–11) in photosynthesis, radioactive iodine (I–128) in a study of the function of the thyroid, and the many experiments, as yet inconclusive, on tumors and cancer. The dangers involved in the use of radium, radon, and certain artificially radioactive substances are indicated.

Most students have acquired the fundamentals of optics in their general physics. It is easy to extend this to a detailed study of ultraviolet light. The effect of ultraviolet radiation on the skin, the mechanism of skin tanning, the use of artificial sunlamps, the absorption of ultraviolet light, and the applications of commercial sterilamps are considered. Ultraviolet irradiation of oils and foods is an interesting related field.

The premedical student and biology major should be familiar with the histology of a nerve cell. But it is often a surprise to learn that the nerve fiber is equivalent to an electrical circuit composed of resistance, inductance, and capacitance in series, with applied direct electromotive force. The action potential, a wave of activity along a nerve following a stimulus, is a measurable quantity. The speed at which the impulse travels along the fiber may be shown to be related to the degree of myelination of the fiber. A study is made of methods of stimulation, the potentials and reactions to stimuli. Much work has been done in this field with the nerve cells of the giant squid, with *Nitella* cells, and with certain smooth-muscle cells.

The physical principles associated with the eye and the ear are important biophysical concepts. The biophysicist is particularly interested in the lens of the eye, its defects and accommodation. The entire optical system is studied, with emphasis on its general structure. The response of the eye to light of different wave lengths and intensities is discussed. The mechanism of ordinary vision and of color vision, while in some phases psychological rather than physical, usually arouses much interest. Through the cooperation of the department of psychology, visiting lecturers have presented the psychological aspects of vision. Demonstration color blindness tests are quite popular.

The classical theory of sound waves and wave motion may be related to the mechanism of hearing. The structures of the ear, intensity thresholds, audibility measurements, measurements of noise, nerve response to sounds, and the fundamentals of acoustics are a few areas for investigation and discussion.

A study of some of the new instruments used in biological and medical research may be included. These are the electron microscope, the cathode ray oscillograph, the electrocardiograph, the electroencephalograph, and the various types of colorimeters and hemoglobinometers. The method of operation and application of each is important, not the intricate electrical circuits contained therein.

Additional topics which may be covered in a longer course are ultra-centrifuge applications, studies of surface phenomena—such as osmotic pressure, molecular layers, and membrane studies—more detailed spectroscopic applications, artificial fever rays, photoelectric measurements, neutron therapy, and experiments on photosynthesis and cancer.

The number of suitable textbooks for

introductory biophysics is limited. There are two rather familiar ones written specifically for undergraduates, Otto Stuhlman—*An Introduction to Biophysics* (1) and David Burns—*Introduction to Biophysics* (2). Otto Glasser's *Medical Physics* (3) contains many sections which are biophysical in nature, but this is too encyclopedic a work to be considered as a text. Related texts are Matthew Steel—*Physical Chemistry and Biophysics* (4) and N. Rashevsky—*Mathematical Biophysics* (5). The most valuable material for teaching purposes is found in the many articles in current medical, biological, and physical journals. These may be used as part of the course material, or for supplementary reading. The Stuhlman and Glasser texts contain extensive bibliographies.

The importance of this branch of applied physics is shown by the establishment of research institutes and graduate research programs at the leading universities of the country. These include the University of California, the University of Pennsylvania, University of Michigan, Massachusetts Institute of Technology, University of North Carolina, and Tulane University. Biologists and physicists will utilize the results of these investigations. A sound introductory course in biophysics will be of great value in the interpretation of these results.

1. John Wiley, New York, 1943.
2. Macmillan, New York, 1929.
3. Year Book Publishers, Inc., Chicago, 1934.
4. John Wiley, New York, 1928.
5. University of Chicago Press, 1938.

Topical Outline for One-Hour Course

Week 1. *X-Rays.* From physical point view.

Week 2. *X-Rays.* Biological applications, therapy, protective measures, units and instruments for measurement.

Week 3. *Natural Radioactivity.* Physical basis, radiations, units, dosage, therapy.

Week 4. *Artificial Radioactivity.* Fundamental experiments of Rutherford and Curie-Joliot, cyclotron construction and use.

Week 5. *Artificial Radioactivity.* Tracer experiments in biology and medicine.

Week 6. *Ultraviolet Light.* Introduction to spectroscopy, nature of radiation, skin reaction, tanning, sterilization procedures, irradiation of foods.

Week 7. An hour test on the first six weeks work. Objective tests have been used.

Week 8. *Nerve Conduction and Stimulation.* Histology of the nerve cell, action potentials, reaction to stimuli, after potentials, mathematical interpretation.

Week 9. *The Eye.* Structure of the eye, its optical system, defects, spectral sensitivity, mechanism of vision.

Week 10. *Psychological Theories of Color Vision.* Guest lecturer—a member of the department of psychology.

Week 11. *The Ear.* Fundamentals of wave motion, sound and acoustics, the structure of the ear.

Week 12. *The Hearing Process.* Detailed discussion, including audibility measurements, intensity determinations.

Week 13. An hour test on the second five weeks work. Test may or may not be objective.

Week 14. *Survey of Instruments.* Cathode ray oscillograph, electroencephalograph, electron microscope, electrocardiograph.

Week 15. *Final examination.*

In addition to the routine classwork, each student is required to prepare a report on a current journal article in the field of biophysics.

Topical Outline for Three-Hour Course

Week 1. *X-Rays.* Physical characteristics, absorption, scattering, units and instruments for measurement.

Week 2. *X-Rays.* Biological applications, therapy, protective measures. Demonstrations of X-ray units, tubes, r-meters.

Week 3. *Natural Radioactivity.* Physical basis, radiations, units, spectra, dosage, therapy, production of radium and radon.

biological applications. Demonstrations of cloud chamber, spinthariscope, ionizing ray counter, radioactive minerals.

WEEK 4. *Artificial Radioactivity.* Rutherford and Curie-Joliot experiments, the construction and use of the cyclotron, chemical reactions of artificially radioactive materials.

WEEK 5. *Artificial Radioactivity.* Tracer experiments in biology and medicine. Demonstrations of tracer salts (if available).

WEEK 6. *Ultraviolet Light.* Introduction to spectroscopy, nature of the radiation, skin reaction, tanning, sterilization procedures, absorption, irradiation of foods. Demonstrations with fluorescent minerals, paints, and solutions.

WEEK 7. *Infrared Light.* Nature of radiation, skin reaction, therapy, intensity measurements.

WEEK 8. *Surface Phenomena.* Surface energy, interfaces, phagocytosis, osmosis, osmotic pressure, solution constants, applications to plant and animal cells. Demonstrations.

(During the first eight weeks, at least two tests are given).

WEEK 9. *Nerve Conduction and Stimulation.* Histology of nerve fiber, methods of stimulation, action potentials, after potentials, reaction to stimuli, mathematical analysis.

WEEK 10. *The Eye.* Structure of the eye, the optical system, defects, spectral sensitivity, mechanism of vision. Demonstration of model eye.

WEEK 11. *Color Vision.* Special lecture by member of department of psychology. Color blindness tests for class. Color mixing demonstrations.

WEEK 12. *The Ear.* Fundamentals of wave motion, sound, acoustics. The structure of the ear, mechanism of hearing, audibility measurements. Audibility tests on members of class.

WEEK 13. *Survey of Instruments.* Cathode ray oscillograph, electroencephalograph, electrocardiograph, electron microscope, betatron, synchrotron, photoelectric colorimeters, ultra-centrifuges. Emphasis in each case on the biological applications of each. Demonstrations where possible.

WEEK 14. *Recent Advances in Biophysics.* Reports by members of class on current articles in the field.

(During the last six weeks, at least one test should be given in addition to the journal report)

WEEK 15. *Final examination.*

HERPETOLOGICA

This strange-looking word is the title of the official organ of THE HERPETOLOGISTS LEAGUE, an organization consisting of individuals interested in the study of amphibia and reptiles—herpetology. Membership in the League includes a subscription to *Herpetologica*, which is published at irregular intervals, for the duration of one "volume" of the journal. It is more or less technical in nature, valuable to the serious hobbyist as well as the professional snake-hunter and his allies. If you are interested in finding out more about the only publication in the country, perhaps in the world, devoted exclusively to the study of amphibia and reptiles, address inquiries to the editor of Herpetologica, CHAPMAN GRANT, *2970 Sixth Ave., San Diego 3, California.* If you are even more interested, send him thre dollars for a one-volume membership in THE HERPETOLOGISTS LEAGUE.

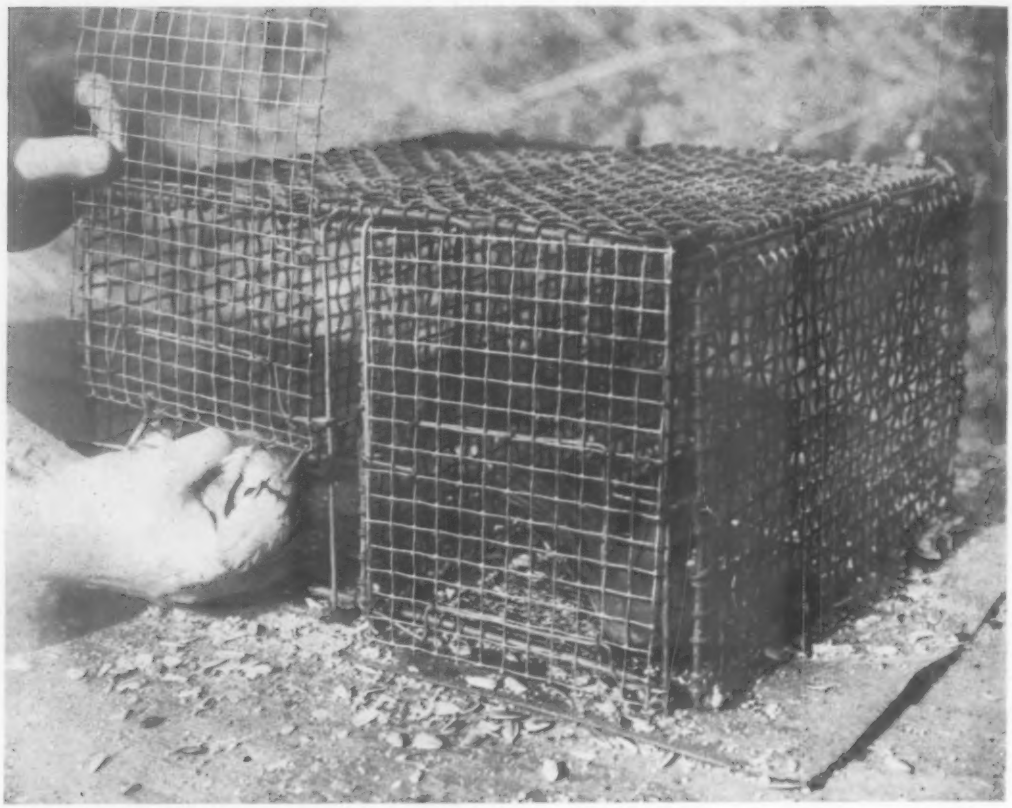
PLASTIC BLOCKS FOR BIOLOGY SPECIMENS

Successful development of a transparent plastic mounting in which delicate, soft-bodied biological specimens are permanently preserved for laboratory and classroom study has been announced by Dr. Dean L. Gamble, President of Ward's Natural Science Establishment of Rochester.

Called *Bio-Plastics*, the new preparations consist of small blocks of clear plastic in which are embedded pig and chick embryos, cartilage structure, jellyfish and other "soft" biological forms.

With the introduction of Bio-Plastics, educators and educational institutions may obtain specimens in a form that is both permanent and easy to handle. The plastic blocks may be studied under standard dissecting microscopes, viewed under hand lens, or examined from all surfaces with the naked eye.

For information on Bio-Plastics, write Ward's Natural Science Establishment, Inc., Rochester, N. Y.



A Blue Jay is removed from a two-celled Potter Trap, while a Cardinal waits in the adjoining cell. Both birds were attracted by the sunflower seeds, grown on the campus of St. Joseph's College. All photos by the author.

Bird Banding on a College Campus*

REV. JOHN W. BAECHLE
St. Joseph's College, Rensselaer, Indiana

Audubon is usually credited with having been the first person in America to band birds. About 1803, he used silver wire to mark a brood of Phoebes, and the following year he found that two of the marked birds returned to nest in the same vicinity.

Little is known of bird banding activities from that time until a century later when, in December, 1909, the *American Bird Banding Association* was organized. In order to expand and further promote this valuable phase of ornithology, the United States Biological Survey took over the project in 1920. From that time until the end of 1945, a period of 25 years, a total of 4,833,442 individual birds of over 430 different species were banded, and a total of 346,237 **Return** records were reported. At present, bird banding is under the supervision of the Fish and Wildlife Service, Department of the Interior, Washington, D. C. A

* Reprinted with minor changes from the September 1946 issue of *The Science Counselor*, published by Duquesne University Press, Pittsburgh, Pennsylvania.

few years ago there were 1,600 persons in the United States engaged in this project, and as soon as the Fish and Wildlife Service is able to obtain more clerical help it is hoped that the number of active bird banders may be increased greatly.

Every authorized bird bander must obtain a Federal permit, and in some states, he must likewise have a state permit in order to capture and band song birds. The banding of waterfowl and other game birds is restricted to government game preserves. Every bird bander must be at least 14 years old, and must furnish proof, in the form of testimonials, that he is sufficiently acquainted with birds to recognize easily the species common to his locality. He must also either own or have access to books on the identification of birds so that he can correctly identify any strange birds he may catch. All banders are warned against banding any bird about whose identity they are not certain.

The bands to be used come in about ten different sizes, and are furnished by the Fish and Wildlife Service in the quantities requested by the bander. The bands are made of aluminum, and on each is stamped the inscription, "Notify Fish and Wildlife Service, Washington, D. C." This inscription is abbreviated and stamped on the inside of the smaller sized bands. Each band likewise has a number stamped on it. This number begins with two digits to indicate the year the band was issued, and then, separated by a hyphen, are from four to six other digits. No duplicate numbered bands are ever issued. Special form blanks, for sending in the semi-annual report on newly banded birds, special cards for reporting "Return" birds as well as envelopes, which require no postage, are furnished each bander. There is no charge for the permits, bands, report blanks, and envelopes, but neither is there any pecuniary recompense for the work done by the banders.

Applying a band to a young Mourning Dove.

Each bander must furnish his own equipment in the form of traps, bird food, etc. A copy of *Manual for Bird Banders* by Frederick C. Lincoln and S. Prentiss Baldwin is furnished to each. This manual gives descriptions and diagrams for the constructing of many types of approved traps with which to catch the birds without harming them. It also gives instructions for the proper handling of the birds along with various ways of attracting them, and a table indicating the proper sizes of bands to be used on most of the common species of birds to be banded.

Some of the interesting facts about birds which have been and still are being discovered through bird banding, as enumerated by Lincoln and Baldwin, are as follows:

1. Migration—When do certain species arrive in a given locality and when do they leave? Is the same route followed for both the spring and the fall migration? Do birds return to the same winter and summer quarters? What effect has weather, *e.g.*, a storm, upon migration? Do males, females and young travel together, or, if separately, which comes or goes first?

2. Territory—What is the range-limit during the breeding season? What is the limit during the winter or other seasons?

3. Ecological Preferences—What is the preferred habitat of various species? Can certain species be attracted away from their preferred type?

4. Family Groups—What is the length of time that the unity of the family is preserved?

5. Permanent Residents—Are so called "permanent residents" the same individuals, or is there a movement of greater or less extent in such species?

6. Mating Activities—Does polygamy, polyandry, or inbreeding take place? Which species breed when one year old? What part is taken by both sexes in nest-building and the care of young? When is incubation begun, and do the eggs hatch in the order in which they were laid? What is the number of broods per season?

7. Longevity—What is the normal length of life of different species as shown by yearly returns?

8. Personality—Do individual birds have peculiarities in appearance, habits, and manners?

As to various methods of capturing the birds, trapping them is the most common, but there are other methods, such as finding young birds still in the nest, and catching them at night with the aid of a flashlight and net. The type of trap and kind of food used for bait varies according to the kind of bird to be caught. We have about 20 traps of four different types on the campus of St. Joseph's College. The traps must be located where they can be inspected about every hour

The author inspects one of the five Purple Martin houses on the campus of St. Joseph's College.

lest the captured birds injure their beaks or feathers by being held captive too long. During the nesting season the traps should be visited even more frequently so that the parent birds are not detained too long and as a result either the incubating eggs or the young neglected. I find it quite easy to enlist a number of my biology students to aid in the work, especially during the migration periods, and when banding is in progress. These students also keep me posted as to the location and progress of the many nests on our extensive campus.

Young birds are usually banded a few days before they are ready to leave the nest. The same sized band must always

be used on nestlings as would be used on an adult bird of the same species. Every year we band several hundred birds of the following species: Purple Martins, House Wrens, Barn Swallows, Robins, Mourning Doves, and Blue Jays. With the help of several students we have created on our campus five large Martin houses with a total of over 70 compartments. We have made and erected over 50 Wren houses. Next year we hope to build and place quite a few Blue Bird houses.

Catching birds at night is another phase of banding which we indulge in and enjoy very much. During the migration seasons especially, we capture many birds with the aid of a flashlight and net. On one occasion we caught six different species in less than one hour, while the birds were roosting in a small grove of evergreens. There are a few species which we have caught only at night, because they never frequent our traps. Most of the Starlings which we have banded were caught at night while they were roosting in our dairy barn. On one occasion two of us caught within 20 minutes with our bare hands over 140 Starlings. We usually "raid" the Martin houses about three times each spring before the birds begin to nest. Since Martins never frequent the traps, this is the only way we can capture the adults and thereby catch the birds which were banded several years before.

If a banded bird is caught within three months of its previous capture at the same banding station, such a bird is called a REPEAT. The presumption is that the bird has been in the vicinity all the time. If more than three months elapse between two successive trappings of the same bird, such a bird is called a station RETURN. The presumption in this case is that the bird had been away from the locality and had returned. If a banded bird is either caught or found dead at a great distance from the banding station, such a bird is called a RECOVERY.

The author catches birds at night, with head-light and net, on the campus of St. Joseph's College.

We began to operate our banding station at St. Joseph's College on April 12, 1941. During the approximately six years since that date, we have banded over 10,000 individual birds of 78 different species. Over 3,000 birds were caught as *Repeats*, and 224 birds were caught as station *Returns*. Our number of *Recovered* birds, however, is rather low, for only 40-odd birds banded by us have ever been reported to Washington as having been caught or found dead elsewhere.

It is well for all bird banders to stress to any group they may have the opportunity to address on birds or bird banding, the importance of looking for bands on the legs of dead birds. The author never misses a chance to explain bird banding to any interested group, and especially to school children and scout groups. It is easy to gain the cooperation of children in looking for and reporting banded birds that might be found dead along a highway or elsewhere. All that is necessary is to send the complete band number to the Fish and Wildlife Service, Washington, D. C. A penny post card suffices. If possible, the cause of death and the approximate date of death of the bird should be given,

as well as the species, if that is known. When such a report is received in Washington, the persons in charge first check to see to whom the band was issued. Then they look through the file of reports from that bander to see on what bird the band was placed. The person who found the bird will then receive from Washington the following information: The kind of bird it was; when, where, and by whom it was banded; whether it was a young or an adult bird, whether it was male or female, and how it was originally caught—for these are the things which the bander must include in his semi-annual report on every bird banded by him. A second report will be sent from Washington to the bander telling him when, where, and by whom his banded bird was found, as well as the cause of its death, providing that information was reported to Washington. In case a bird bander lives near the person who finds a dead banded bird, it is better to report the band number to that bander, because most likely the bird was banded by him, and he will have the information on hand concerning the dead bird.

The fact that many birds repeat frequently shows that they are not shy of the trap, but merely know where to go to get a free meal. Several years ago I caught a Black-capped Chickadee over 30 times within a few weeks, and one Indigo Bunting was caught in my traps three times within a half hour. Quite a few of our banded birds are caught as station Returns for several successive years. The very first Cardinal which we banded on May 17, 1941, has been caught in our traps every year since then, and sometimes several times in the same year. This male Cardinal was an adult when first banded, so it must have been hatched not later than 1940, which would make it at least six years old now. The last time it was trapped was during the Graduation Exercises at St. Joseph's College on June 2, 1946. This fact led someone to observe that perhaps the Cardinal thought he'd report for his diploma after so many years on the college campus. Since the Cardinal is usually classed as a permanent resident the chances are great that this individual has seldom, if ever, left the vicinity of the campus since its birth six or more years ago. This Cardinal, however, does not hold an old age record, for A. F. Gainer, of Nashville, Tennessee, has record of a Cardinal which is over 13 years old.

Although we have but few Recoveries to boast of, some of our banded birds have traveled quite far from our campus. We have received reports of some of our birds having been found in the following states: Florida, Mississippi, Georgia, Louisiana, Ohio, Missouri, Illinois, and Indiana. Four birds, all Starlings, were found in Canada several months after we had banded them. The greatest distance from St. Joseph's College that any of our birds has been found is a little over 1,200 miles.

A few of the species of which we have banded large numbers in the past five years are: White-throated Sparrow 2,400; Slate-colored Junco 1,983; Starling 1,480; Robin 889; Purple Martin 394; Barn Swallow 328; Mourning Dove 313; House Wren 270; Blue Jay 184; White-crowned Sparrow 114; Brown Thrasher 100; and Cardinal 91.

Editor's Note: Under date of March 5, Rev. Baechle wrote as follows:

"We have handled several thousand birds as REPEATS, viz. we caught them within three months after we had banded them. We caught 163 birds of 19 different species as RETURNS, viz. after more than three months had elapsed since we had last caught them. There were 40 individual birds of 16 different species reported to Washington as RECOVERIES, i.e. they were found—some

dead and some alive—at some distance from our banding station. The bird which was found farthest from St. Joseph's College was a White-throated Sparrow which was caught by Mr. M. G. Street, another bird bander. This bird was banded here last May, and was caught on October 3, 1946 at Nipawin, Saskatchewan, Canada—over 1,200 miles Northwest of our campus. It was the first RECOVERY of a bird of that species out of almost 2,500 individuals we have banded. We have never caught a RETURN. The corrected figures to date are as follows: White-throated Sparrow 2,475; Slate-colored Junco 2,039; Starling 1,549; Robin 917; Purple Martin 454; Barn Swallow 355; Mourning Dove 328; House Wren 382; Blue Jay 184; White-crowned Sparrow 104; Brown Thrasher 105; Bronzed Grackle 111; Cardinal 97; Song Sparrow 84; Swamp Sparrow 78; and Catbird 69."

Developmental Philosophy in the Teaching of Biology

The developmental philosophy and its application in the teaching of biology lies between the inflexible course with its rigid memorization on the one hand, and the laissez-faire course with its lack of direction on the other hand.

One can readily visualize the type of teaching that goes on in the inflexible course of study. This authoritarian type of teaching assumes the use of one textbook which is to be accepted in toto and makes little or no use of other sources of information. Although not consciously, it accepts the philosophy that the mind of the student is like a blank sheet upon which the letters or ideas may be typewritten. On the other hand the laissez-faire type of course of study places a premium on indulgence and excessive freedom, assuming that if the student's interests are allowed free play he will automatically tend to meet his own needs.

The developmental philosophy in the teaching of biology assumes that certain fundamentals need to be taught so that the child may have the tools to grasp the complex ideas and concepts which exist in the field. From here on, the student is guided or directed to projects, readings, reports, drawings, and discussions in relation to his individual likes and capacities. This developmental approach aims to bring out the best potentialities of the child.

The fundamentals to be learned may be taught from well-organized units of which most modern textbooks are now patterned. The selection of the textbook to be used would depend upon the character of the school. Generally speaking any restriction as to selection of a single textbook throughout a large school system is diametrically opposed to an individual teaching situation. The classroom must contain a large library of references, textbooks, and magazines. This is necessary so that the student may have his activities and readings guided with the teacher ready to help at any moment. In the teaching of a unit on heredity, for example, the material would be presented in the form of a guide sheet which is so prepared as to give a foundation in fundamentals of heredity. Then the student is directed to reports, activities, discussions, experiments, problems, and other textbooks in accordance with his capacities.

Underlining this entire approach to

the developmental philosophy in teaching of biology one recognizes that the teaching load must be small. Large classes practically destroy any successful attempt to put this type of instruction into being. School administrators as well as the general public must realize that human minds cannot be built like machines and that each individual has a distinctive growth pattern.

BARNEY BARNETT COHEN,
Von Steuben High School,
Chicago, Illinois

THE STUDY OF HUMAN BLOOD

When your class is ready to study human blood apply a leech to the skin of some person (there are always students ready to volunteer) for a few minutes. If the skin is first wet with normal salt solution the leech will take hold at once. After the annelid is removed blood will continue to flow from the wound for many minutes, owing to the anti-coagulant secreted by the leech. Excellent fresh mounts can be made for the entire class from a single wound. The blood may be studied as long as desired since it will not clot on the slide as does blood drawn with a needle or other instrument. Although not yet tried out by the writer, there is no apparent reason why the same method would not prove successful with other vertebrates in case a comparative study of the bloods of vertebrates is to be made.

EDWARD C. COLIN,
Chicago Teachers College,
Chicago, Illinois

Our readers will have a special interest in *Biology for You*, reviewed on page 218 of this issue; both authors have been active contributors to the welfare of both the NABT and *The American Biology Teacher*, since the early days of the Association.

NOT A MERE LOG

The accompanying photograph of an unusual natural curiosity was a part of a news release from Wentworth Military Academy, Lexington, Missouri. The log, which could be "carried like a suitcase," was brought in by the Grounds crew from the Country Club of the Academy. Examining the log is Captain Clyde Etter, biology instructor in the science department of the Academy. He is pointing to the place where the tree branch was probably grafted several years ago. The log was an American elm, about six inches in diameter. The branch, about one inch in diameter, showed no sign of grafting except at the point indicated by the pencil.

BY THE WAY

WE HAVE BEEN PASTING the colored pictures of birds, chick embryos, and the like, from *Life* and other magazines, on cards made of Bristol Board (any good grade of mounting board would do) and filing them. In order to simplify the filing problem, we are pasting them on two sizes of cards, 4×6 and 7×10.

THIS IS THE TIME FOR FROG EGGS; last year we made a series of stages by removing and preserving a few specimens at daily intervals, all the way from the eggs to the actively swimming tadpoles.

FORMALIN is a 40% solution of formaldehyde, in water. If your preserving directions call for 10% formalin, remember that the dilution is made from the stock solution as 100%; in other words a 10% formalin solution consists of *nine* parts of water and *one* part of the 40% stock solution of formaldehyde.

"CIRCULATING BLOOD can be demonstrated in the external gills and in the tail of a very young tadpole better than in any other type of preparation I have ever tried."

SCIENCE TALENT SEARCH SCHOLARSHIPS AWARDED

For the sixth year, 40 high school seniors, recognized for possessing "an unusual science potential," have been awarded scholarships to help them continue their scientific educations. The awards were made March 4 at Washington to finalists in the annual Science Talent Search, the nationwide activity conducted by Science Clubs of America through Science Service and supported by the Westinghouse Educational Foundation, which is maintained by the Westinghouse Electric Corporation.

Top awards, four-year scholarships of $2400 each, went to Martin Karplus of Massachusetts and Vera Radoslava Demerec of New York, both 16.

Karplus, who plans to enter Harvard, major in biology and then devote his life to medical research, stands first in a class of 750 at Newton High School, Newtonville, Massachusetts. Miss Demerec plans to enter Swarthmore to study zoology and then make a career of museum work. She is ranked among the top students in a class of 185 at Huntington High School.

BIOLOGY NIGHT OPEN HOUSE

Brookline High School, Brookline Massachusetts, will hold its Second Annual *Biology Night* this year on Monday and Tuesday evenings, June second and third. It will be held in the Brookline Gymnasium on Tappan Street from 7:30 P.M. to 9:30 P.M.

This event marks the completion of specialized biology project work carried on by one hundred and thirty-nine students. It is interesting to note that this year only four students asked to work with someone taking the same project, therefore, the fields of interest which will be exhibited will be wide and varied.

Last year, approximately twenty-five hundred people, including parents, townspeople, and biologists from near-by schools and colleges, attended during the one evening the exhibition was held.

We extend a most cordial invitation to all biology teachers and students alike to attend.

I might add that I plan to submit an article in the near future explaining in detail the nature of this learning activity. I was prompted to do this after the enthusiastic way you received my students who exhibited their projects before The National Association of Biology Teachers at the Hotel Bradford on December 28, 1946.

Sincerely yours,
IRVING C. KEENE,
Teacher of Biology,
Brookline High School

RECENT PUBLICATIONS

YAHRAES, HERBERT. *Rheumatic Fever, Childhood's Greatest Enemy.* Pamphlet No. 126, Public Affairs Committee, Inc., 22 East 38th Street, New York 16, New York. 31 pp. 1947. 10 cents.

Non-technical description including causes, influences of heredity and various other contributing factors, treatment, prevention, programs for community action, and things that can be done by persons interested in helping.

BRUNSON, MRS. DEWITT, and DOWLING, THOMAS I. (Editors). *Suggestions for the Teaching of Science in the Twelve-year School Program.* State Department of Education, Columbia, South Carolina.

The result of a cooperative study during the summer of 1945, with 136 people participating in two study-conferences. Detailed outlines of content, methods and materials, as follows:

Science—Primary Level
Science—Intermediate Level
General Science—High School Level
Biological Science—High School Level
Chemistry—High School Level
Physics—High School Level

Lists of films, chemicals, equipment, and references follow the discussions of the respective sciences and levels. Biological Science is divided into seven units as follows:

1. Overview of Biology
2. The Distribution and Diversity of Life
3. The Fundamental Life Processes of Animals and Plants
4. Nature's Plan for the Continuation of Life
5. The Interdependence of Living Things
6. Development in the Animal Group
7. Seasonal Biology

RECENT GOVERNMENT PUBLICATIONS

The following books and pamphlets are included in a recent list distributed by the Government Printing Office. All may be obtained by remitting the indicated amount to Superintendent of Documents, United States Government Printing Office, Washington 25, D. C.

Until the Doctor Comes. Government Printing Office, 15¢. Catalog No. FS2.8: 18.

Contains simple emergency directions which can be readily applied, which will add to the comfort of the injured, prevent more serious complications from arising, and in some instances contribute to the saving of the life of the patient.

Human Nutrition. Government Printing Office, 40¢. Catalog No. A1.10/a:1668.

This part of the *Yearbook of Agriculture*, 1939, has proved so popular that it is presented in separate form for those interested in the collection of articles on human nutrition which it contains, but who do not need the entire volume.

Fishery Resources of the United States. Government Printing Office, 40¢. Catalog No. 79–1:S. Doc. 51.

The kind and extent of the fishery resources, how much we know about them, what remains to be known, how we have applied and failed to apply our knowledge, and what the future holds for our fisheries through broad and adequate programs of conservation. Such material as methods of catching, breeding habits, waters where they are found, legal limitations on fishing or size of the catch, and extent to which the species remains at the present time.

Ecology of the Coyote in the Yellowstone. Government Printing Office, 30¢. Catalog No. 129.13:4.

One of the series of wildlife conservation bulletins issued by The National Park Service, this publication is of particular interest to naturalists, but can also be of service to teachers of natural history, biology, and geography. There is extensive discussion of relations of the coyote to other animals found in the Yellowstone region, such as the mule deer, antelope, bighorn, bison, moose, bear, muskrat, gopher, field mouse, squirrel, rabbit, beaver, and porcupine. There is the usual large number of excellent photographs which National Park Service publications customarily contain, together with a workable bibliography and index.

Wildlife Portfolio of the Western National Parks. Government Printing Office, $1.25. Catalog No. 129.2:W64.

An effort has been made to present photographs of the outstanding or characteristic species of wildlife found in some of the Western National Parks. The fifty-two photographs are of living wild animals, living in their natural habitats, and the essential native characteristics and charm of the animals have been preserved insofar as possible. Descriptions of the mammals, birds, and reptiles covered in each photograph.

Biological Briefs

Cook, Robert C. Dr. Muller Receives Nobel Award. *The Journal of Heredity*, 37: 325–326. November, 1946.

The effect of X-rays upon organisms is a story with several strange and tragic chapters. Not the least fantastic of these is the story connected with the award of the 1946 Nobel Prize in medicine. This award was made to Herman J. Muller, Ph.D., professor of zoology, Indiana University, for his work in discovering that mutations, biological changes in species, may be produced by X-rays. He made this discovery almost a generation ago.

In the world in turmoil through the explosion of the atomic bomb, this award emphasizes a very important truth. Not only did the bomb bring quick or lingering death to a hundred thousand people, but it also temporarily sterilized several times that many. This proves that they have been exposed to heavy enough radiations to have profound and yet undetermined effect on the germ plasm of the Japanese people. The effect of the radiations from the bomb in creating pools of lethal and deleterious genes is yet unknown, but there is no reason to believe that a whiff of atomic energy can be calculated to improve human germ-plasm.

Many early workers with X-rays in physics and medicine, paid with their lives for rash chances taken in tinkering with this new force. No one conceived though that within a generation entire populations might be exposed to mass irradiations and that the Muller-effect might become one of the most important public-health problems.

GREELEY, W. B. Trees and Jobs for 100 Years. *American Forests*, 53: 56–659, 88. February, 1947.

When the Simpson Logging Company signed a recent agreement with the U. S. Forest Service for forest rights during the next one hundred years, the life-long work and planning of Mark Reed was consummated.

Mr. Reed's love of the forest country and love of foresters as well made him a great leader in forest management and instigator of this permanent forest economy. He brought to loggers better working conditions, good schools, and community life; and during his years in the legislature helped shape the early Forest Code of Washington which will insure preservation of one of our most valuable national resources.

The Simpson Logging Company has been doing much conservative work to deserve this century-long contract. Utilization of logging and milling wastes has come in for much research by this company; and as a result, by-products such as industrial alcohol and many types of pressed wood are now made from formerly useless sawdust, shavings, mill ends, and defective wood.

The company has for years followed the practice of careful plantings to keep its lands covered; it has a definite rate and manner of cutting; it has insured the government of ample fire protection. The land leased will be under direct supervision of the government.

This lease includes about two per cent of the forest reserves of the Northwest and is an experiment to determine the advisability of withdrawing forest lands from the competitive market.

LOREN W. MENTZER

Books

WOLCOTT, ROBERT H. *Animal Biology*. 3rd ed. McGraw-Hill Book Company, Inc., New York and London. xviii + 719 pp. illus. 1946. $4.00.

To those who know Wolcott's excellent and widely used *Animal Biology*, the arrival of this revised third edition will be welcome. To include important recent knowledge, many of the chapters have been rewritten and considerably expanded by the late Dr. Wolcott's associates in the Department of Zoology of the University of Nebraska. A few new chapters have been added, as well as a simple illustrated key to the orders of insects, over a hundred new figures scattered throughout the text, and a correlated list of motion picture and film strip teaching aids. This correlated list of film teaching aids is a feature which I am sure you will find most useful.

To those who, perhaps, are not too well acquainted with Wolcott's *Animal Biology*, the text is worthy of your serious consideration. As originally designed by Dr. Wolcott for freshmen and sophomores as a class textbook, not a reference work, the basic tenets of animal biology are presented lucidly, while some of the more technical angles are left to future courses. Parts I and III are devoted to the discussion of fundamental principles; Parts II and IV develop the principles by the "type study method" and are intended to summarize and tie-up knowledge gained in the laboratory; Part V, the concluding section, gives a general survey of the field of zoology, serves to further correlate basic facts, and establishes points of attachment for the articulation of more specialized courses. The numerous illustrations, many of a comparative nature, are aptly chosen and placed to clarify basic concepts. Terminology, always a problem to the student, is carefully handled. All important terms

are in italics and carefully defined in the text; the ample self-pronouncing glossary further obviates this problem.

Dr. Wolcott stated in his preface to the first edition of *Animal Biology*, ". . . the idea is to give the student an amount of material which he can cover in a way he can understand." I would say his aim has been thoroughly accomplished.

RAY KENNELTY

VANCE, B. B.; MILLER, D. F. *Biology for You.* J. B. Lippincott Company, New York. 730 pp. 1946. $2.28.

In recent years much effort has been put into the modernization of secondary school biology textbooks. The wartime had indicated a marked need of inclusion of first aid, gardening material, more than a mere smattering of disease and nutrition. Vance and Miller have put forth a commendable text including the aforementioned topics. Theirs is truly a good modern secondary school biology volume.

Mechanical Make-up: This is a sturdy volume with a simple cover design. The paper is of wear-resisting construction and takes a legible sharp black type. The illustrations, diagrams, line cuts and half-tones are excellently selected with full legends and interesting didactic notations. There is an effort to balance the layout. There are color illustrations and a most pleasing frontispiece and title page. Some of the charts are superb; especially is this true in the chapter on disease.

Literary Style: The material is legible, readable, understandable, simple and direct. New words are italicized for emphasis, with pronunciation of the new terms found in the pronouncing part of the glossary. The latter is much more extensive than is usual in high school texts.

Subject Matter: The authors cover 15 units and develop the following phases of biology: Insects (57 pages), Plant Kingdom (109 pages), Cell Study (28 pages) Animal Classification (54 pages), Physiology (58 pages), Disease, Nutrition and Hygiene (111 pages), Heredity and Reproduction (67 pages), Evolution (25 pages), Conservation (50 pages). Much of the subject matter seems to emphasize knowledge objectives that would be more functional in a suburban and country section than in a city area. A great amount of material directs thinking to a Mid-Western environment. It is commendable that the authors included in this volume material on cancer, gardening, landscaping, first aid, hobby biology. Euthenics is not mentioned in the index and Eugenics receives a three-page treatment. The chapter on disease is most effective. Some will quarrel with the selection and arrangement of the units, but to the alert teacher this is an advantage, since the course can be started at any place and the book adapted to courses of varying length and content.

Teacher Aids and Student Helps: The authors have done an effective workmanlike effort in this direction. They offer the student and teacher dramatic illustrations, color plates, fully elaborated easily read charts, unit review questions in direct, simple wording; *Problems in Scientific Thinking*, fully explained, directed and detailed; *Things to Do*, with projects and activities to perform per unit; a bibliography with extended descriptions and brief notations of content. Almost all references are of recent date. And finally, there is a full glossary. The index is unique in its typography and lends itself readily to examination.

ALAN NATHANS,
Christopher Columbus High School,
New York City

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